

Getting Familiar with RECOVER

RECOVER is a decision support system created with funding provided by NASA Applied Sciences. It uses a GIS-based web map interface designed to enable fire managers to develop better informed post-fire rehabilitation plans.

The RECOVER team continuously compiles a database of current and authoritative geospatial data layers (land cover, natural resources, transportation, etc.) for the entire Western United States. The web map was developed to allow our partners (you) to view and query these layers with nothing more than a desktop web browser.

Overview: This exercise will allow you to acquaint yourself with the RECOVER web map interface and experience it from the fire manager's perspective. By analyzing an example fire, you will determine what areas will need the most focus and resource deployment for ecosystem rehabilitation and recovery.

At a glance...

We will explore the features of the RECOVER web maps and learn how to navigate the map and use its capabilities to allow you to best leverage all of RECOVER's potential.

Steps:

1. We will explore a fire that occurred a few years ago. We call it the *Exercise fire*.
 - a. Launch your web browser and navigate to:
https://recover.giscenter.isu.edu/recover3/ExerciseFire_UT/

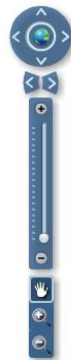
Note: you will need a user name and password to access RECOVER's active fire sites. If you do not have one, simply send an email request to Keith T Weber (webekeit@isu.edu).

NAVIGATING THE USER INTERFACE


Read and click "Agree" from the Welcome splash screen.

Next, let's take some time to get acquainted with the Navigation of this web map.


- b. Try using the Navigation Widget in the top left corner of the map.









The directional button with a globe in the center , pans the map in the direction of the arrows. Clicking the globe resets the view to its original extent.

The two arrows  below the directional button allow you to go to the previous extent and back to the next extent.



The slider  controls the zoom level.

- c. The mouse can also be used to zoom to specific areas using the “Zoom in”  or “Zoom out”  tools (you can find these buttons beneath the pan tool button ).
 - d. Using the Zoom in button , click and drag a rectangle around an area you would like to explore more closely. You can also use the mouse wheel to fine-tune the area you have zoomed to.
 - e. Try using the mouse to navigate. Make sure the Pan  tool is selected in the Navigation Widget.
 - Click and Drag moves the map around.
 - Scrolling the Mouse wheel forward zooms in.
 - Scrolling the Mouse wheel backwards zooms out.
2. Next we will learn to toggle (i.e., turn on/off) the individual layers provided by RECOVER.
- a. If the Layer List & Legend pane is not already visible, click the Layer List & Legend button  located near the top center of the webpage. This will bring up the “Layer List and Legend” widget.

RECOVER web maps are organized using layer groups (e.g., RECOVER Baselayers).

- b. Click the arrow to the left of a layer group to reveal its individual layers. Make sure to expand the RECOVER Baselayers group.
- c. Take a look at the legend for each layer. To do this, click the arrow to the left of an individual layer (e.g., Roads)
 1. RECOVER Baselayers.
 - a. Vector data (A representation of the world using points, lines, and polygons).
 - Fire Boundary
 - Roads
 - NHD (National Hydrology Dataset) ¹
 - Habitat (Sage Grouse) ¹
 - Wetlands (National Wetland Inventory [NWI])
 - PLSS (Public Land Survey System)
 - SMA (Surface Management Agency) ²

¹ Source USDOI- BLM.

- Geology²
 - Watersheds WBD (Watershed boundary dataset)¹
 - Soils_SSURGO³
 - Soils_STATSGO³
 - Soils_STATSGO_KFactor
 - Landslide Potential¹
 - HistoricFires
- b. Raster Data (rasters are digital aerial photographs, imagery from satellites, digital pictures, or scanned maps).
- HistoricFire_PastDecade
 - Ecosystem Resilience and Resistance
 - FRG_FireRegimeGroup⁴
 - BPS_BioPhysicalSetting⁴
 - ESP_EnvironmentalSitePotential⁴
 - EVC_ExistingVegetationCover⁴
 - EVT_ExistingVegetationType⁴
 - Steep_Slopes_GTE30deg (slopes \geq 30 degrees)
 - Elevation¹
 - Aspect¹
 - Hillshade
 - Slope_degree (Topography Slope)¹
 - Slope_percent (Topography Slope)¹
2. Debris Flow Probability. This layer may or may not appear on each RECOVER web map as they are considered “additional datasets” at the discretion of the land manager requesting RECOVER’s services. The layers included here display the likelihood of a debris flow following a 24mm per hour rain event (approximately ¼”) (note: we will explore these data more closely later in the exercise).
3. Fire Affected Vegetation (dNBR). This layer is another “additional dataset” that may not appear on all RECOVER web maps. This layer was created using the dNBR equation and displayed using a green–red color ramp with red indicating areas most affected by the fire.

To display a layer, the layer group first needs to be turned on, by placing a check in its check box. Secondly, the specific layer within the group needs to be turned on.

- d. Try toggling some layers on/off again using the check box.

² Source USGS.




³ Source NRCS

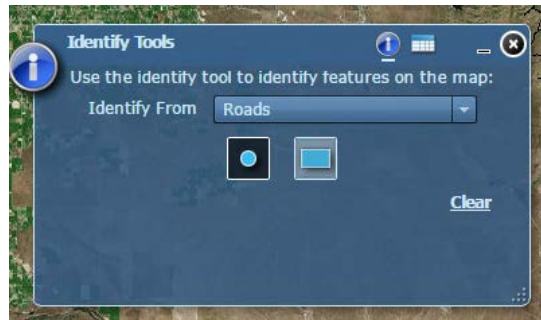
⁴ Source Landfire program

All data were acquired from these sources and prepared for use by ISU’s GIS TReC as part of the NASA RECOVER project.

THE IDENTIFY TOOL

3. Now we will learn to use the Identify Tool

- a. Click the Identify widget  (located to the right of the Layer List & Legend widget on RECOVER's tool bar). This will open the Identify Tools window.
- b. In the *Identify from* drop down menu, select the layer you want to identify (the layer must be displayed/activated (checked) in the Layers List and Legend)
- c. Choose to Identify either a specific point  or all GIS data within a rectangle . When identifying using the rectangle tool, the widget pane will look like the one shown below:



- d. Finally select the feature you want to identify on the map.
 - e. Its attributes will show up in the Identify Tool popup.
 - f. To get some practice using the Identify Tool, turn on the Ecosystem Resilience and Resistance base layer and identify a blue colored area within the fire perimeter. What information is provided? (Enter your answer in the space below).
4. Other widgets are provided by RECOVER, but we will not explore all of these in this exercise (feel free to browse these widgets and try them out on your own).
- Map Coordinates
 - Bookmarks
 - Import Tools
 - Print

VIEWING REPORTS

5. Also provided in the RECOVER DSS are various reports, all contained within a single PDF document for your convenience. These reports give quick access to information on the fire such as acres burned, administrative agency, and SSURGO-derived soil associations impacted by the fire.

- a. Open the reports by clicking the “hamburger” menu in the top right corner of the application.



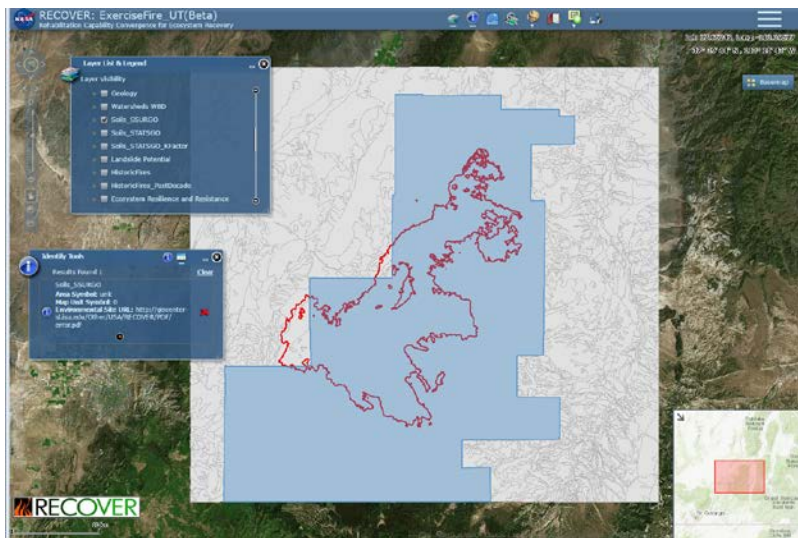
- b. Click “Reports” and the PDF reports will open in a new browser tab.
- c. Review the data in the Summary Report (page 1) and write the total number of acres burned in the space below.


- d. Which agency had the largest acreage of land burned?

- e. Scroll down to the Detailed Fire Report (page 3).
- f. Look at the areas burned that are managed by the BLM.
- g. Of these areas, what SSURGO soil association *Map Unit Symbol* had the highest number of acres burned?

- h. Return to the web map once again by clicking its browser tab.
- i. Close the menu by clicking the X

6. Return to the Layer List & Legend
7. Turn on the Soils_SSURGO layer (within the RECOVER Baselayers group)
HINT: You may need to turn off other layers as GIS always draws layers from the bottom to the top of a layer list.
8. Next, using the Identify tool, identify any soil polygon within the fire perimeter.
 - a. You should see a screen *similar* to the one shown below.



- b. From the Identify tools results window click the small black and orange arrow button 
- c. A new tab will open in your browser displaying a PDF report that further describes the Ecological site identified by that map unit symbol (note: you can easily download and keep these reports from your browser's interface).

You will notice an Ecological site report is not available for this particular area. This is unfortunately the case with numerous areas across the western US. To visualize a complete ecological site report, click here <http://giscenter-sl.isu.edu/Other/USA/RECOVER/PDF/ID/ID709/35-PlantAssociationVegetation.pdf>

Note: All available Ecological Site reports have been prepared and staged for you on RECOVER's servers.

Next, we will walk through two scenarios using the RECOVER web map to help address some simulated management questions or concerns.

Scenario 1:

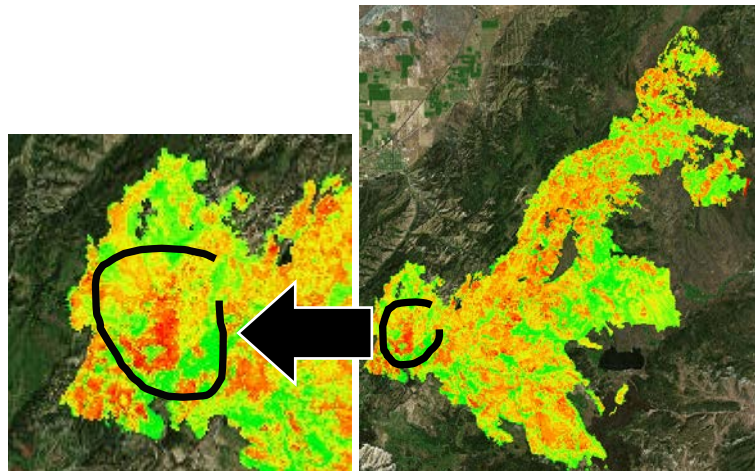
At a glance...

We will use the RECOVER web map to identify those areas with high priority for native grass reseeding treatments. We will apply a highly simplified approach in this exercise using the Fire-affected vegetation and Ecosystem Resilience/Resistance layers.

Your job as a post wildfire manager is to identify priority areas for reseeding. Let's get started.

USING THE DRAW TOOLS

9. Turn on the Fire Affected vegetation layer and take a few minutes to get acquainted with it (you may wish to turn off all other layers).
By exposing its legend, you should see the areas most affected by the fire shown in red while areas experiencing little affect from the fire are shown in green.
 - a. Click the arrow to the left of a layer to reveal its legend
 - b. One of the largest areas showing substantial fire effect (darkest red) is located in the "lobe" found in the southwest corner of this fire.




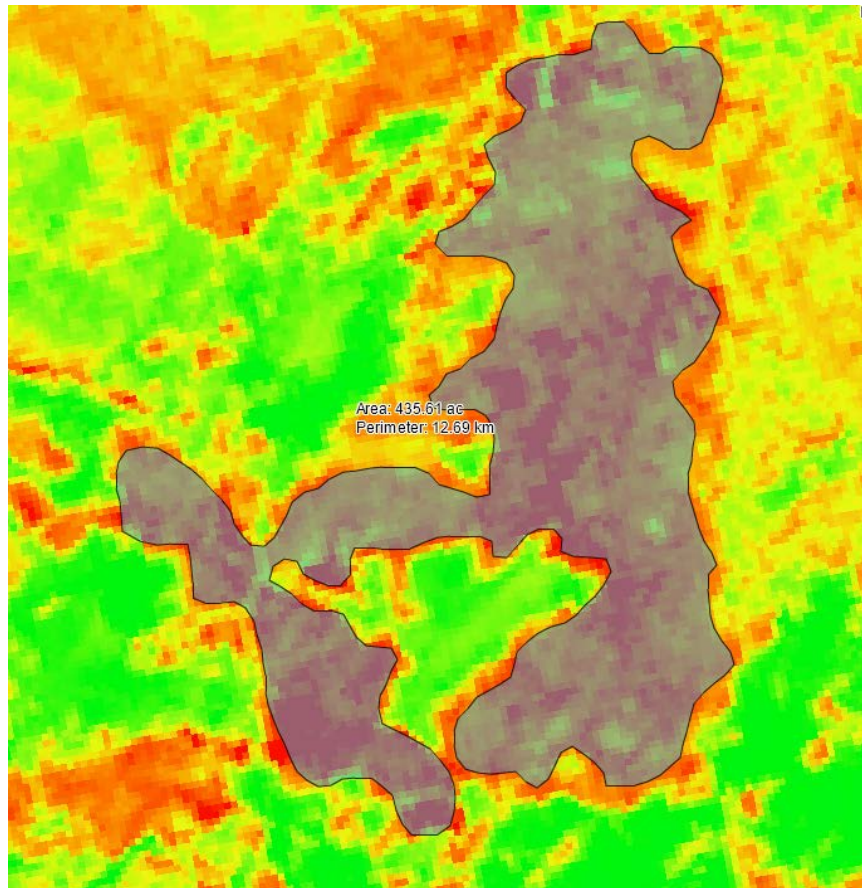
- c. Zoom into this area

This is currently a candidate for reseeding. Let's approximate the number of acres the area represents.





10. Click the Graphics tools widget.


- a. Select "Draw and Measure"
- 
- b. Choose to draw a polygon
 - c. Click the "Show measurements" check box near the bottom of the Draw and Measure window.
 - d. Change the area units to Acres
 - e. Move your mouse cursor into the map area. We will trace the area highly affected by the fire (dark red) and this requires your judgement (see the challenge exercise section for a more highly quantified approach).
 - f. Click anywhere to begin drawing
 - g. Move your mouse cursor and click again as you trace this feature being sure to click again at each important vertex (change in direction of your perimeter)
 - h. Double-click to finish your drawing
 - i. When completed your map area may look similar to that shown below.



- j. I got approximately 436 acres. What did you get?

11. Next, let's save this graphic using the Save Graphics Layer button  near the top-right corner of the Draw & Measure window.
 - a. Read the notice regarding fonts, etc. and click YES
 - b. Navigate to your desktop.
 - c. Name this file ConcernArea .txt
 - d. Click Save
12. Similarly, you can add "saved graphics" to your map using the "Open Saved Graphics Layer" tool. 

DOWNLOADING ALL THE DATA

The technique we just used provides an estimated acreage for reseeded. To arrive at a more precise answer will require the use of ArcGIS software. RECOVER allows you to access these same layers by clicking the menu  and choosing Data Download. You can do this now or later during the challenge exercise.

13. Next, we will integrate the Ecosystem Resilience and Resistance (RR) layer into our analysis.
 - a. From the Layer list, locate and turn on the Ecosystem Resilience and Resistance layer (once again you may wish to turn off all other layers)
 - b. What is the resilience category for the area you just digitized (drew)?

While your digitized area experienced a substantial affect from the fire it may not be a candidate for reseeded as the ecosystem is considered highly resilient to disturbance. Let's move on to another use scenario of the RECOVER DSS.

Scenario 2:

At a glance...

We will use the RECOVER web map to identify areas that may present a danger from landslides and debris flows. We will also identify the areas that may be prone to extensive erosion in order to focus treatment efforts.

Erosion prevention and landslide safety are two additional important considerations in post-fire management. Both erosion and landslides can occur very quickly following a wildfire, changing the landscape and potentially causing considerable damage to the ecosystem. Wildfires can remove plant life and litter that help slow or minimize erosion, therefore it is important to curb these processes as best possible.

We will begin by using the "Landslide_Potential" layer located in the Baselayers group. Let's get started:


14. Turn off all layers except "Fire Boundary"
15. Close all widget windows except the Layer List & Legend.
16. Locate the Landslide potential layer within the RECOVER Baselayers group and turn it on.
17. Using the identify tool, what is this area's potential landslide incidence?

A more exhaustive examination of landslide/debris flow probability was completed by the USGS Landslide Hazards program for this fire. Let's take a look at these data.

18. Locate and Turn on the Debris flow probability layer.
 - a. Expand this layer group so you can see the legend.
 - b. Notice, this layer indicates the likelihood of a debris flow following a 24mm/hour rain event.
 - c. Further, notice there is only one area (three polygons) indicating high probability.
 - d. Overall then, the two layers (Landslide potential and Debris flow probability) tend to agree.
19. To better understand and use the debris flow layer, take a look at its documentation in RECOVER's reports. To do this:
 - a. Click the menu button in the upper right corner of RECOVER's interface.
 - b. Click Reports
 - c. Scroll down until you see the yyyZZZZ_dfestimates... README page.
 - d. Review this information so you are more familiar with these data.

Note: The full set of data described here is available to you in RECOVER's download package.
20. Return to the RECOVER web map.
21. Using any of the other layers available to you, can you discern why these three basins have a high probability of a debris flow?
 - a. This will not be easy, nor will it be conclusive. However, using RECOVER's 26 base layers along with the additional data layers available for this fire will allow you to better understand the fire event and plan for its future recovery.

USING THE SWIPE TOOL

22. Are there areas within the fire perimeter that have both high debris flow probability and high fire-affected vegetation ratings (fire "severity")?
 - a. To help visualize this, you can use the swipe tool.
 - b. Click the Swipe/Spotlight tool
 - c. Next, we need to setup the tool (see the figure below)



- d. The active layer needs to be set to the layer that is drawn on TOP (the one that will be peeled away during the swipe). In our case, set Debris flow probability as the Active layer.
- e. Make sure the Fire Affected Vegetation layer is turned on.
- f. Select to use the Swipe tool by clicking the Swipe button.

- g. Place the mouse cursor over the map.
- h. Notice the cursor has changed and now looks like a black arrow.
- i. The direction the arrow is pointing changes relative to the center point of the screen.
- j. Place the cursor somewhere to the right of your screen's center point (the black arrow will now point to the left)
- k. Press and hold the left mouse button
- l. Drag the mouse to the left to peel away the debris flow layer and reveal the underlying fire affected vegetation layer.
- m. Is there a relationship between the high debris flow probability area and fire "severity"?

- n. Experiment with both the swipe and spotlight.

These may be areas you would like to focus on during a field visit or post-fire monitoring.

USING WORLDWIND

Before leaving the RECOVER DSS, let's look at a new data visualization tool added to RECOVER. It uses NASA Worldwind technologies in a highly automated way (i.e., you do not need to setup anything, just click the NASA Worldwind link from RECOVER's menu).

- 23. Open RECOVER's menu
- 24. Click NASA Worldwind.



A new tab will open and the globe will zoom into this fire area. We have chosen to display the Fire-affected vegetation layer for this exercise.

- 25. Notice the control buttons in the lower left corner of this window. Refer to the figure below, to learn how each button operates.



- 26. Initially, Worldwind may not look much different from RECOVER in that we are viewing the GIS data from zenith (directly overhead). Worldwind's abilities really lie in 3-D data visualization. Let's explore this now.

Notice each set of tool buttons is stacked vertically. For example, one button zooms in (top) while another button zooms out (bottom).

- a. Locate the Change perspective tools. The top button moves your viewing perspective to zenith (directly over the top of the data), while the bottom button moves your perspective toward the horizon. Click the lower change perspective button  and hold it until you like the perspective you are seeing.
- b. Next, let's adjust the elevation exaggeration to enhance our visualization. Click and hold the exaggerate elevation button  until you like what you are seeing (this is subjective and dependent upon you!).
- c. Experiment with the rotate globe tools and zoom in/out while you visualize fire affected vegetation areas.
- d. You can also use your mouse to drag the globe around the screen. Note, holding the left mouse button while dragging functions different than holding the right button while dragging. Check it out!
- e. And finally, you can use the mouse wheel to zoom into and out of the globe.

Different layers (or numerous layers) can be used in Worldwind. Click the link below to view a demonstration where we used the USGS Debris flow probability layer in Worldwind.

<https://youtu.be/hq11h1Y9EvM>

This exercise provides a quick look into the capabilities of the RECOVER DSS and its value for post-wildfire planning. Some benefits of RECOVER are:

- 1) All geospatial data for a given fire are available in a single browser environment (they are available in a single geospatial context).
- 2) The web map can be created very quickly (approximately 5 minutes) for a given fire and you can even do this yourself any day or anytime as the RECOVER servers operate 24 hours per day, 7 days per week, and 365 days per year.
- 3) A refresh of the DSS and web map due to an updated/growing fire perimeter is easy and fast (just contact the RECOVER team at RECOVERdss@gmail.com)
- 4) Users of RECOVER do not need GIS software, but only a desktop web browser and internet connection
- 5) The RECOVER web map can be integrated with Collector or Survey123 data (real-time apps) so data collected in the field are available for use within the web map in real-time.

CHALLENGE EXERCISES (optional)

27. From the results of the previous scenario you identified areas within the fire perimeter that have both a high probability for landslide and high fire-affected vegetation ratings. Within these areas are there also regions with steep slope values?

The Steep Slope layer is a visual representation of degree of slope across the fire area (i.e., the steepness of the area). Areas with greater slope values tend to have a higher water erosion and landslide potential due to the velocity of the runoff.

To address this question you will use the skills you have already been practicing

- a. Turn on the SteepSlope layer (found within the RECOVER Baselayers group) (note: this layer identifies areas where slopes are ≥ 30 degrees).
 - b. You may wish to experiment again with the Swipe tool (widget) to help you visualize these data.
28. Describe the results of your analysis.

If you wish to perform more advanced processing in the desktop environment using ArcMap or other GIS software, the fire-specific data from the RECOVER web map can be downloaded! Let's experiment with this now (note: you will need to have ArcMap installed on your computer to work through this part of the exercise):


29. Download these data by clicking the menu in the top-right corner of the application
30. Select "Data Download".

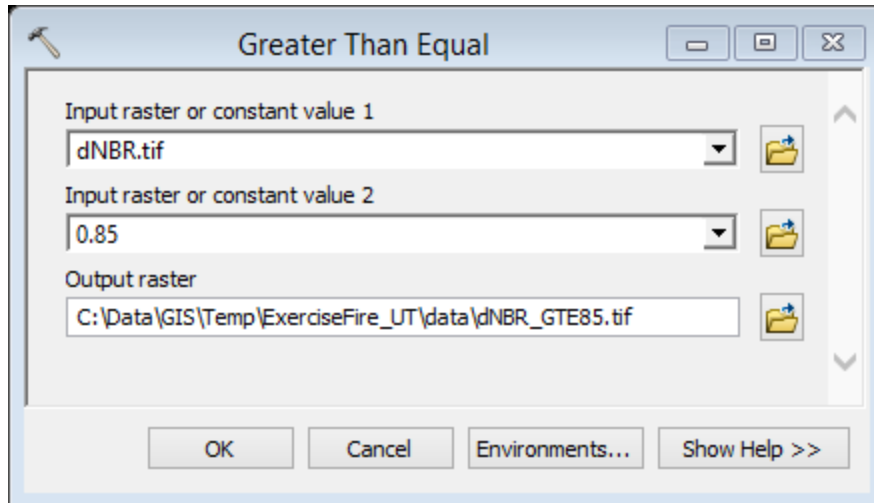
After a few minutes the ZIP package will be downloaded to your computer.

31. Using Windows Explorer, navigate to the "Downloads" folder. Here, you will find a ZIP file named ExerciseFire_UT.zip.
Of course, the name of the download package changes depending on the fire you are working on. Our naming convention follows [FIRE NAME]Fire_[STATE].zip.
32. Extract the ZIP file to your computer (TIP: I like to choose Extract to folder... as this approach helps me keep the individual fire data files separated and organized for me).
 - a. Once the files have been extracted, navigate into the folder.
 - b. You should see one PDF file. This is the reports file you viewed earlier in the exercise.
 - c. You should also see a Data folder.
 - d. Double-click the data folder to navigate into it.
 - e. Inside the Data folder you will find a geodatabase (GDB) called "Data.gdb". This GDB contains all the RECOVER vector baselayers.
 - f. You will also see a number of different files (e.g., Aspect.tfw and Aspect.tfw). These are the RECOVER raster layers (baselayers and any additional layers such as the dnBR fire severity layer).
 - g. There will also be a Metadata folder. Locate it and double-click it to navigate into it.
 - h. You will see all our metadata ($n = 26$, one for each baselayer) are stored as HTML documents. Double-click any one of the documents and it will open in your web browser.

- i. Once you have completed viewing the metadata, return to the Data folder.
- j. Next, navigate into the PostFireDebrisFlowEstimates folder.

These data are created and provided by the USGS Landslide Hazards Program.

- k. In this folder, you will find a geodatabase, XML-based metadata, an ArcMap document (*.MXD) and a readme.PDF file (note: this file is also included in the complete reports.pdf we looked at earlier in this exercise).
 - l. We will be exploring some of the data contained in the GDB later in this challenge exercise. For now, just navigate back to the root “ExerciseFire_UT” folder.
33. The last folder we will explore is the Maps folder. Double-click it to navigate into it.
- a. You should see an ArcMap.mxd (map document). Locate it and double-click it to launch ArcMap (note: if you do not have ArcMap on your computer, this will fail).
34. Once ArcMap launches, you will see its table of contents contains the same 26 RECOVER base layers in the same draw order as in the web map. What you do not see, are the additional data like the dNBR, debris flow, or long-term NDVI data. The data download contains these data so it is a simple matter of adding them to ArcMap. Here is how we will do it:
- a. Click the add data button from ArcMap’s menu 
 - b. Navigate to the location where the ExerciseFire data is stored (Note: you may need to modify your ArcGIS folder connections to complete this).
 - c. Make sure to navigate into the ...\ExerciseFire_UT\data folder
 - d. Select the dNBR raster dataset.
 - e. Click ADD
35. Now, let’s zoom into the fire area. To do this, simply right-click the FireBoundary layer and select “Zoom To Layer”.
36. You will notice the symbology used for the dNBR.tif (Fire affected vegetation layer) is currently displayed in gray scale. Feel free to change this if you wish (RECOVER uses the “Condition number” color ramp).
37. Locate the same area where we previously identified a high fire affect had occurred.
- a. Use the ArcMap Identify tool to determine the pixel values for these “high” fire affect areas.
 - b. You will see the actual values vary quite a bit however, it looks like values >0.85 will capture most of the high fire affected areas.
38. We will use ArcMap’s raster calculator to identify all pixels in the dNBR layer having a value ≥ 0.85 Here’s how:
- a. Open ArcToolbox
 - b. Navigate into SPATIAL ANALYST TOOLS—MATH—LOGICAL
 - c. Open the Greater Than Equal tool by double-clicking it (Note: If your installation does not have a license to use the Spatial Analyst extension, you will not be able to complete the balance of this exercise).
 - d. Complete the tool’s dialog as shown below:



- e. Click OK
- 39. The output ...ExerciseFire_UT\data\dNBR_GTE85.tif is a Boolean layer where pixels having a value of 1 have been evaluated as TRUE for your expression. In other words, 1 = places where the dNBR values were ≥ 0.85 .
- 40. How many acres does this represent? To figure this out, follow these steps:
 - a. Open the raster attribute table for the new dNBR_GTE85.tif layer (right-click the layer and choose open attribute table).
 - b. You should see there are 8,357 *pixels* having a value of 1 (dNBR ≥ 0.85). But these are pixels and not acres.

Well, how many pixels are in an acre? The answer to this is it depends... it depends upon the size of each pixel. So, we need to do a bit more digging to determine the size of the pixels for our dNBR_GTE85.tif layer.

- c. Right-click the dNBR_GTE85.tif layer
- d. From the fly-out menu, choose Properties.
- e. Click the Source tab from the Layer Properties window
- f. Locate the Cell Size entry (X,Y)

Property	Value
Raster Information	
Columns and Rows	1505, 1522
Number of Bands	1
Cell Size (X, Y)	20, 20
Uncompressed Size	2.18 MB
Format	TIFF
Source Type	Generic
Pixel Type	unsigned integer
Pixel Depth	8 Bit

- g. You should see these values are 20, 20. Scrolling down further, you will also see the linear units used for this layer are meters, so each pixel is 20 x 20 meters in size or 400m²

41. Now, let's do a bit of math.

$$8,357 \text{ pixels} \times 400 \text{ m}^2 \text{ per pixel} = M$$

$$M / 4046.85 = \text{Acres} \text{ (there are } 4046.85\text{m}^2 \text{ in each acre)}$$

You should get 826 acres

42. Next, turn on the Ecosystem Resilience and Resistance layer.

43. We need to determine if any of these areas experiencing high fire affect coincide with an area having either moderate or low resilience. To do this, first determine the numeric value for the high, moderate and low resilience classes using the RR_class field found in the Ecosystem Resilience and Resistance layer's attribute table. Use the Identify tool to complete the table below:

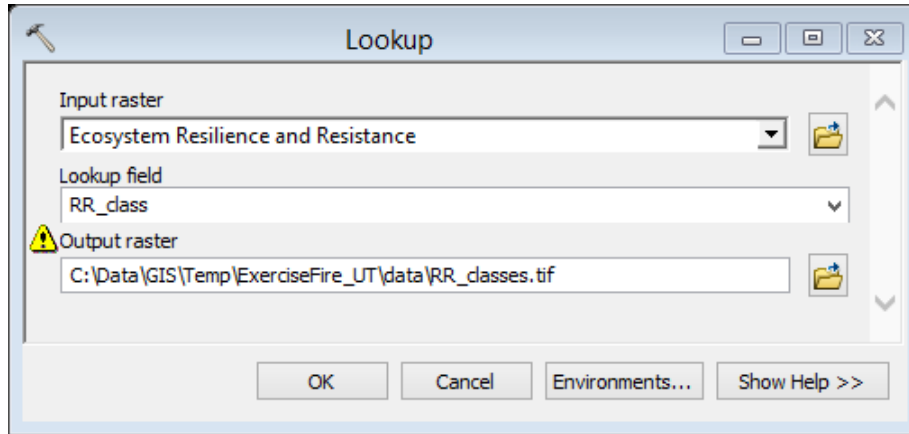
Ecosystem Resilience and Resistance Class	Numeric Pixel Value (RR_Class)
High	
Moderate	
Low	

44. You should see the moderate and low resilience classes have values of two and three, respectively.

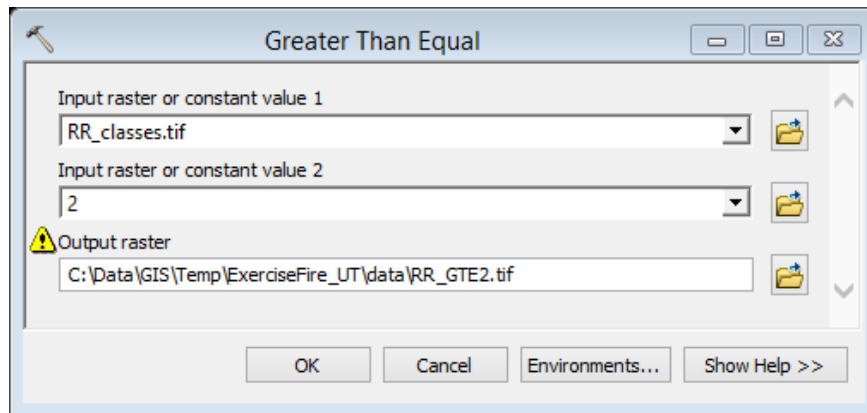
- Use the same analytic tool to identify all pixels greater than or equal to 2
- Save the output raster layer as RR_GTE2.tif
- Hmm, something looks wrong with the output, doesn't it? You should see all pixels were evaluated as true (≥ 2). This is because ArcGIS operates on the VALUE of the pixel and not any of its additional attributes. Take a minute to look at the attributes of the Ecosystem Resilience and Resistance layer by right-clicking the layer's title in the table of contents and choosing Open Attribute table.

45. Solving this problem is not impossible however and here is how we can do it using the Lookup tool:

- From ArcToolbox, expand SPATIAL ANALYST TOOLS--RECLASS
- Open the Lookup tool
- Complete this tool's dialog window as shown below

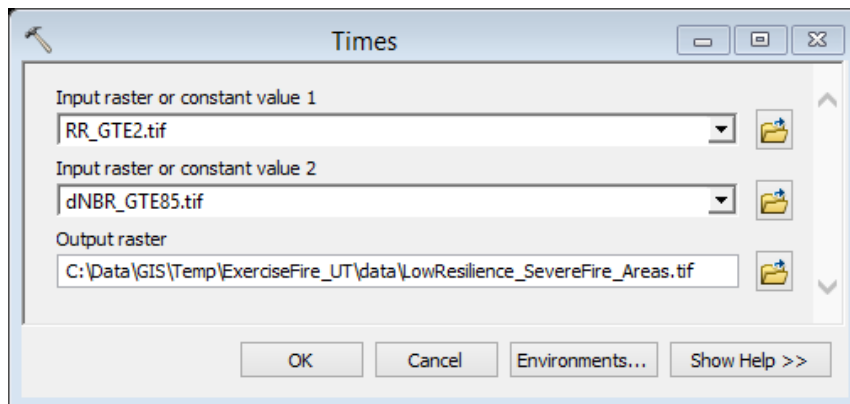


- d. Click OK to run the tool (this should complete in about 1-2 minutes).
- e. It is all downhill now! Use the Greater Than Equal tool once again to locate all pixels with an RR value ≥ 2 and allow the previous RR_GTE2.tif layer to be overwritten in the process (see below).



- f. Click OK

46. Next, let's put both of these datasets together and get an answer. We will use the Times tool found in ArcToolbox (SPATIAL ANALYST TOOLS—MATH) to multiply both Boolean layers together.



47. Interestingly, you should see three (3) pixels satisfy this criteria (moderate to low resiliency AND relatively high fire severity (≥ 0.85)).

a. How many acres is this? (HINT: these are 20 x 20 m pixels)

b. While these results are correct and true, will you be able to apply specific management to this area?

I hope you enjoyed this workshop and exercise. If you have questions (now or in the future), please let the RECOVER team know by emailing me at webekeit@isu.edu. Thank you.

END